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ABSTRACT

The manual provides vocational and technical teachers with a review of the principles of learning which have application to their subject fields. Organized into three sections, the booklet offers: (1) a selected review of the literature related to how learning theory is applied to instruction; (2) principles of learning that have been identified as having application to classroom teaching, subdivided into those related to motivation and those related to instructional methods and teaching strategies; and (3) principles of learning related to instructional media, conditions, and materials. The reader can find the lesson component in which he is interested (attention, presenting stimuli, promoting retention, etc.) listed in the table of contents and learn what research has to say about the area of his concern on the page cited. (Author/AJ)

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LEARNING RESEARCH AND PRINCIPLES AS APPLIED TO CLASSROOM TEACHING: PART 1

Research Coordinating Unit
Bureau of Vocational Education
State Department of Educational
and Cultural Services
Augusta, Maine 04330

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LEARNING RESEARCH AND PRINCIPLES AS APPLIED TO CLASSROOM LEARNING: PART I

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PREFACE

The purpose of this manual is to provide vocational and technical teachers with a review of the principles of learning which have application to their subject fields. The booklet has two sections: (1) a selected review of the literature related to how learning theory is applied to instruction; and (2) a listing of principles of learning that have been identified as having application to classroom teaching.

This preliminary report is designed to provide teachers with an outline of the components of a lesson, categories of learning and the uses of certain instructional media. An additional manual is being prepared to provide teachers with a list of learning principles, procedures to accomplish these principles, and examples of their uses.

HOW TO USE THE MANUAL

The teacher should utilize the table of contents to identify the component of the lesson or learning principle he wants to read about. For example, if the teacher is concerned about what research has to say about gaining attention of the student, he would turn to page 10 of the manual.

If he wants to read about the psychomotor skills, he would begin reading on page 16 and also look at the principles listed, starting on page 69.

A bibliography of sources is included if the teacher wants to do further reading on a topic. All sources are identified in the report by author and date. For example, Skinner (1957) would be quoted in the text. The reader would turn to the bibliography and look for the name which is in alphabetic order and the citation having the appropriate date and would find the publisher or source of the information.

Introduction

Learning can be defined as a modification of behavior (in the broadest sense of the term, including skills, responses and knowledge) as a result of experience. Learning is a process that results in several products, primarily in the form of changes in specific types of behavior. The quality of any educational system is generally defined in terms of changes in learner behavior. These changes in specific ways of behaving have often been referred to as types of learning. Some of these are listed below:

1. Simple responses are associations of previously established behavior with a new stimulus, such as a baby crying when an unfamiliar face is presented. (also called stimulus-response learning)
2. Muscular habits include both simple and complicated organizations of motor skills, such as walking, grasping, writing, or driving an automobile.
3. Perceptual responses are our interpretations of sensory impressions. We see, hear, or receive other sensory messages in terms of our experience which gives it meaning. For instance, we hear a sound which we interpret as a plane overhead. The sound, therefore, has a meaning to us. To someone who has never heard a plane the sound would be meaningless.
4. Motives are for the most part learned. Social or psychological motives are learned through our interaction with the environment. The ways in which we satisfy our physiological motives are learned. We learn, for instance, when to eat and what to eat, as well as how to eat.

5. Attitudes may be described as a variety of predispositions to respond to selected aspects of the environment. Attitudes toward people, institutions, or objects are learned. Attitudes are generally positive or negative, as for example, our attitude toward capital punishment or a particular political candidate.
6. Emotional responses are also learned. Even though the visceral response is reflexive and involuntary, we learn the objects of fear and love. We also learn from our peers how to express our emotional responses.
7. Problem solving is one of the most sophisticated learnings of man. This involves the application of old experience to a new problem or situation, such as when a man lost in a forest follows a stream or uses a compass to avoid wandering around in a circle.
8. Language is the system of expressions (such as words and symbols) with which we learn to represent the world around us and to communicate with others.
9. Personality is the personal and unique pattern of traits and tendencies of an individual. Most personality attributes are generally learned, although they are also influenced by hereditary forces.
10. Transfer of training is the application of a learned response to a new situation.
11. Memory is the function governing remembering and forgetting.
12. Creativity is the capacity to think and act with originality, spontaneity, innovativeness and inventiveness.

These specific types of learning or products of the learning process have been distinguished here for semantic convenience. However, it should be understood that these are not necessarily interdependent or unrelated but, in fact, may be highly interrelated in some cases.

The primary type of learning occurring within the vocational-technical classroom is the learning of psychomotor skills. For example, working with sheet metal, operating a lathe, or building a cabinet are all relatively familiar skills to be learned by the industrial arts student. Psychomotor learning involves organized patterns of skill activities that are as much intellectual as physical.

The research on psychomotor skill learning suggests that there are three basic phases in the development of most skills: an initial cognitive phase, a relatively extensive practice or application phase and a final autonomous phase. These are not completely distinct phases but rather tend to be developmentally continuous within the progression from one to the other. However, in most instances of skill learning the following sequence is more or less discernable:

1. Cognitive phase - here the learner attempts to mentally assimilate or to comprehend the fundamental aspects of the skill and the behaviors required to accomplish it. Traditionally, this initial phase has been implemented via the use of didactic instructional techniques such as textbooks, lecture and verbal exposition, although recent research has shown there is merit in learner participation and discovery approaches even at this early neophyte stage. The learner's behaviors during this stage are slow and uncertain and he tends to be visibly conscious of each phase of the action pattern.

2. Practice-fixation phase - in this phase the essential component actions of the skill are practiced repeatedly to the point that the learner is able to repeat the correct pattern of action with a minimum of errors. Although the actual practice activity is the primary element of this phase, the cognitive phase remains active as the learner becomes more aware of the finer aspects of the skill and discovers various methods of avoiding or correcting any errors that he has been making.
3. Autonomous phase - it is here that the mature stage of the skill is attained. The pattern of the behavior becomes virtually automatic to the point that the learner can now perform the actions without intentionally concentrating on them. This final phase is characterized by many discernable facets: increased facility, speed and accuracy, proper timing, anticipation of most circumstances surrounding the task, knowledge of the finer points of the skill, etc.

In order to accomodate the development of this sequence, the teacher must effectively arrange and manipulate those situations or conditions which will lead the learner to eventually modify his own behavior. In the teaching act, the instructor possesses the total plan; he knows the skill or task in its entirety, he is familiar with the various component parts and how they comprise the whole. He typically has a strategy or method for teaching the skill with the intention of transferring the program to the learner. He hopes for an eventual degree of skill which is sufficiently stable so that it can be executed almost automatically with minimum need for voluntary control - in short a habit pattern.

In order to accomplish these teaching objectives, the vocational-technical instructor must have an adequate knowledge of the principles and laws which govern the learning process especially as they may contain relevance for the specific types of behavior involved in the instruction of his particular

skill area. As a result of the extensive review of the literature available on this topic, a compilation of learning principles emerged. Where possible, an attempt was made to provide illustrations and examples of actual classroom situations which tend to typify or demonstrate the practial implications of each principle.

Teachers are frequently bombarded by information and communications from college courses, teacher's manuals and textbooks, in-service training activities, administrators, the media, advertisements for school equipment and textbook series, and many other sources on the subject of how to effectively promote learning in the classroom. Because the teacher is the designer of instructional strategies, he is often faced with the dilemma of choosing among many educational products and methods in order to accomplish his desired objectives. A sound knowledge of verified principles of learning and learning theories will significantly facilitate this decision-making process for the teacher. Understanding of learning principles and theory is also important for the successful delivery and management of instruction which requires that the teacher arrange and structure the learning environment in such a way that students achieve educational objectives most effectively. This important phase of teaching is critically dependent upon knowledge of the learning process and the principles which govern it.

Thus, a knowledge of learning principles can reasonably be expected to assist in the planning stages of instruction, in the actual conduct of instruction by guiding the teacher's choice of strategy, and finally in the assessment states where principles help to identify means of comparing what the learner is able to do with what he is expected to do. When teachers verify their activities against the standards of learning principles which have been empirically established, they first minimize grossly ineffective or inappropriate actions which fail to promote learning, and second, they

establish attitudes which support learning as the focal point of their instructional activities.

Section I of this report contains an extensive review of the relevant research related to the learning process. Section II contains the list of principles which have been compiled and summarized from the research evidence presented in the relevant literature sources available. The list is by no means intended to be exhaustive but is rather assumed to be representative of the major conclusions derived from research on the process of learning. For semantic convenience the principles have been grouped into several specific sub-topics within the broader area of learning.

I. REVIEW OF THE RESEARCH

In investigating the literature on the application of learning theory and research and instructional theory and research to teaching and learning in the vocational technical field, a number of approaches were used:

1) Computer searches of the literature were conducted by identifying keywords from the list of ERIC descriptors and terms from Psychological Abstracts that related to the topics under study.

2) Reference books and sources were utilized, such as specialized encyclopedias, specialized reviews of literature, selective bibliographies, and yearbooks and publications of appropriate specialized groups.

3) Specialized texts and journals were checked.

4) Abstracts and Indices not utilized in the computer search of the topics were checked.

5) Microfilm and hard copies of pertinent documents were studied.

The searches were conducted through four organizations:

1) The American Psychological Associations Psychological Abstracts

2) Lockheed's Computerized Information Retrieval System

3) The National Technical Information Service of the U. S. Department of Commerce

4) The Smithsonian Science Information Exchange

The PASAR (American Psychological Association) search identified key abstracts of journal articles, texts, and dissertations related to the psychological aspects of the topics under study.

Lockheed's computerized search included search of the topics from the following sources:

ERIC (Educational Resource Information Center Bases)

AIM (Abstracts of Instructional Materials in Technical and Vocational Education)

ARM (Abstracts of Research Materials in Vocational and Technical Education)

CIJE (Current Index to Journals in Education)

The National Technical Information Service of the U.S. Department of Commerce (NTIS) provided access to 300,000 technical reports in U. S. Government research from hundreds of federal agencies such as Health Education and Welfare, Department of Commerce, National Aeronautical and Space Administration, etc.

The Smithsonian Science Information Exchange (SSIS) provides pre-publication information on over 170,000 summaries of recently funded research in all fields of science and is daily updated to provide the latest available information.

This chapter will focus on the teaching and learning techniques important in the mastery of vocational skills by the student. There will be three major sections included in this chapter: theories and research on learning as applied to instruction, categories of learning, and theories and research on instructional media.

Schaefer and Law (1973) in reviewing the research on teaching and learning techniques state that there is a paucity of studies of a psychomotor, cognitive and affective learning nature in vocational education. They also conclude that research related to vocational teaching is still in a formative stage. Therefore, included in this review will be general theories of learning and instruction and research from other areas that have application to the vocational field.

Theories and Research on Learning as Applied to Instruction

In analyzing the instructional process to optimize learning, Glaser and Resnick (1972) point out five general requirements:

(1) There needs to be a description on the state of knowledge to be achieved.

(2) There needs to be a description of the entry behavior or initial state with which one begins.

(3) The actions which can be taken or conditions that can be implemented to transform the initial state need to be specified.

(4) Plans for the assessment of the transformation of the state that results from each action has to be completed.

(5) An evaluation of the attainment of the terminal state desired has to take place.

In other words, the instructor needs to be concerned about analyzing the tasks he is to teach, diagnosing the characteristics of the learner, designing the instructional environment and assessing the methods and materials used as well as evaluating the learning outcomes.

Bruner (1966) emphasized that a theory of instruction should be concerned with (1) the question of the kinds of prior experiences that are most likely to predispose the learner to learn, (2) the way in which learners organize and structure knowledge for the most effective learning and (3) a consideration of the sequence of encounters with the materials to be learned that is most likely to result in efficient learning.

Theorists believe that various classes of behaviors that human beings display differ in their stimulus and response characteristics and in the ways in which stimulus and responses are related and structured. Being able to identify these characteristics then helps increase the probability of learning taking place. Analytic descriptions of what is to be learned facilitate learning. Skinner (1957) emphasized the importance of response

learning and environmental or stimulus control. He felt that effective learning is characterized by well-executed performance taking place in an appropriate situation. Effective conditions for learning were seen to lead to response acquisition and the stimulus or context control of these responses.

Gagne (1965) organized a model which related to the management of instruction and included eight components.

The teacher should consider:

(1) establishing techniques to gain and maintain the attention of the learner,

(2) developing within the learner the pre-conditions for learning by giving pre-training, by providing verbal directions, and by stimulating recall,

(3) presenting the stimuli directly involved in learning as actual objects and events, printed materials, pictures, etc.,

(4) aiding the learning process by methods of prompting and guiding; for example, in the form of verbal feedback to the student,

(5) specifying what is expected of the student, the learning outcomes,

(6) providing feedback to the learner about the correctness or incorrectness of his performance at various stages of learning,

(7) using repetition and rehearsal to facilitate retention,

(8) providing examples and guidance to how the task might transfer to subsequent learning or performance.

Attention

Teachers are concerned about the establishment of attentional set. If the stimulus situation fails to control or direct the learner's responses, teachers have failed to get attention. Attention is the alertness or vigilance of the student during the task. Skinner (1953) and Spence (1956) emphasized the importance of the preparatory responses which orientate the learner to observe critical stimuli in situations. Skinner points out

the necessity for the student to continue to look at and listen to the relevant stimuli. Berlyne (1960) found there were three factors which determined what initial attention hierarchies would be. These were (1) innate factors which differ between people, (2) stimulus aspects which emphasize a particular area or give a feature a distinctive tag, e.g., intensity, vididness, size, and (3) specific past learning which helps individuals focus on certain attributes in the situation.

There has been much research on this dimension. Of particular interest is the study by Johnson (1968). He studied the effects of prompting on the learning of university students, using a programmed videotape concerned with student classroom behavior. He found that prompting was effective as shown by post-tests on focusing students' attention to relevant aspects of the pictures.

Current research is being directed to the motivational and instructional variables involved in instructional set and their interactive effects. Little research, however, has investigated the problems of establishing and maintaining instructional sets and protecting them from distractions.

Directing the Learner

The directing of student's behavior so that he improves his performance in a specific task is of concern to the teacher. Normally the teacher uses one of three methods: giving verbal directions, providing pre-training or by utilizing the relevant past learning of the student. In a majority of learning situations in school, the learning task is preceded by some form of verbal directions or instructions. Gagne & Rohwer (1969) in reviewing the research on verbal directions conclude that the phrasing of instructions appears to affect learning efficiency. When learner behavior is contrary to the verbal directions, learning can be facilitated by instructions to elaborate materials presented.

In verbal learning tasks, the effects of pre-training have been examined. Results suggest that the effects of pre-training are questionable. Mandler and Stephens (1967) reported that students, even as young as those in second grade impose structure on the presented materials and that within the limits of their study, the self-imposed structures of the children facilitated learning more than presented structures.

Teachers also find that recall of previous learning can facilitate present learning. Little research, however, has been reported to support this premise.

Presenting Stimuli

Teachers have the option to use a wide variety of materials and methods to present the learning tasks. The third portion of this chapter will deal specifically with the use of instructional media. Teachers have the option of using objects, pictures or words. Rohwer (1967) found with third and sixth graders in a paired associate learning task that pictures produce twice as many correct responses as printed names of the objects depicted. Scott (1967) found that in free recall tasks college undergraduates were observed to recall more objects than word stimuli.

Anderson (1967) in reviewing studies on mode of presentation concluded that the relative efficacy of auditory and visual channels appears to depend upon the characteristics of the subject, such as age, as well as on the task and stimulus characteristics. Gagne and Rohwer (1969) conclude that when there is a choice of method for presenting the same information, pictorial materials are superior to verbal. Concrete verbal materials are preferable to abstract verbal. They state that the stimulus context is one of the most potent of the variables determining the effects of the materials presented and that there is a need for research in the school setting rather than traditional laboratory experiments.

Learning Guidance

The teacher often can insure proper learning by providing extra guidance to the student so that he makes the correct response. Prompting and guidance in the learning process can take a variety of forms and is applicable to many types of learning. Faust and Roderick (1968) tried two versions of an instructional program: one a standard version and a second, a heavily prompted version. Students made higher achievement scores with the standard lesson demonstrating that overprompting can lead to a reduction of achievement or learning effectiveness. In rule learning guidance was found to provide verbal cues which accelerated the acquisition of the task.

Specifying Learning Outcomes

Much attention has been given to specifying the learning outcomes in terms of student behavior which is observable and objective. The method of using instructional or behavioral objectives helps to establish a clearer relationship between objectives and instructional procedures. By using such objectives and evaluation procedures students are able to know exactly what is expected of them. The Instructional Objectives Exchange has a series of objectives available for various vocational and technical subjects grades 7-12.

Feedback

Teachers use the process of reinforcement to provide feedback to their students. The learning theorist has provided many laws of reinforcement which indicate how behavior can be shaped and learned through the use of reinforcement. There are different types of reinforcement; for example, negative and positive reinforcement, primary and secondary reinforcement, etc. The characteristics of the student, the type of feedback, the timing of the feedback, the direction of the feedback and type of task to be learned are variables about which the teacher has to be concerned.

A typical study of Allen (1966) demonstrates the effectiveness of different types of feedback. He used kindergarten and fifth grade students to do a sorting task and used three different types of feedback: praise, criticism, and silence. His dependent variables were persistence and rate of response. He found that praise was more effective for the kindergarten students in all three tasks than either criticism or silence. For the fifth graders, praise and silence was equally effective in the easier tasks (sorting and drawing) while criticism was more effective in the more difficult tasks (puzzles). Johnson (1968) presented teachers twenty-one videotaped scenes of teacher-pupil interactions as a training device to train them to make more accurate observations of specific pupil behaviors. He had three groups of teachers: one given immediate feedback, a no feedback group and an untrained control. The immediate feedback group was superior to the no-feedback group which differed little from the untrained control.

Recent research such as by Kish (1966) has identified a new category of reinforcement which has been labelled "sensory reinforcement." Sensory reinforcement results from the presentation or removal of stimuli of moderate intensity. Besides the effects of visual and auditory stimuli in conjunction with learning tasks, Harlow (1956) found that manipulatory behavior in a puzzle problem was reinforced by the visual, auditory, kinesthetic and tactile consequences of the manipulative behavior itself.

The schedule by which reinforcement is delivered has been studied rather extensively. Morse (1966) pointed out in reviewing studies in this area that the schedule which reinforcement occurs strongly influences behavior and is much more important than the nature and quantity of the reinforcement. Most often in the classroom, the teacher reinforces the student on an intermittent basis rather than a continuous one.

Delay of reinforcement has an effect on learning. The shorter the delay of learning the steeper the learning curve (Spence, 1956).

There is a current interest in schools by teachers, researchers and psychologists in "applied behavior analysis or behavior modification." Behavior modification is based upon the effects of various types and schedules of reinforcers on different types of learning. Considerable generality of the effects of reinforcement on different types of learning has been demonstrated.

Promoting Retention

The teacher is concerned about the retention or amount of learning the student retains. The teacher has to provide practice or drill in the learning of new tasks as well as in some cases stimulate the recall of previous learning that might be needed for present tasks. The proper strategy depends upon the type of learning task. For example, Gagne (1974) proposes the following steps to influence the process of learning a motor skill:

1) presenting verbal or other guidance to cue the learning of executive sub-routine
2) arranging repeated practice
3) furnishing feedback with immediacy and accuracy.

The teacher has to be concerned about the acquisition of learning and what techniques promote acquisition. Two phases that have been of concern to researchers and educators are: whole versus part-learning, massed versus distributed practice. In short term memory experiments Borkowski (1967) and Rothkopf and Coke (1966) found that distributed practice was superior to massed practice in promoting retention.

Transfer

Educators feel that promoting transfer of learning is one of the crucial purposes of instruction. Transfer refers to the degree to which learning a given task will generalize to the performance of the same general class of tasks in different contexts. Gagne and Rohwer (1969) in reviewing the research on transfer state that studies give support to the notion that learning of particular classes of tasks depends upon prior discrimination learning, stimulus coding and response integration. Concept learning is influenced by previous learning on dimensional discrimination; rule learning from prior concept learning; and problem solving from prior learning of relevant rules. Teachers in instructing students can maximize transfer by having students verbalize the learned rules, use sufficient variety of examples of transfer and include some examples as well as non-examples.

Categories of Learning

In this section categories of learning which have special interest to the teacher in the vocational-technical field are discussed. These are psychomotor learning, modeling and observational learning.

Psychomotor Skills

Teachers are concerned with the students learning tasks that involve complex muscular responses, especially the use of equipment. Using a hammer, sewing by machine, driving a car involves motor skills. These skills are sometimes called psychomotor and perceptual motor skills.

There have been several attempts to classify objectives in the psychomotor domain. Simpson (1966) presented one system of organization of classifying objectives in this area based upon the complexity of the sequence involved in the performance of the motor act. She includes seven levels. Her scheme is included in Table 1.

Fitts and Posner (1967) described three phases of learning a motor skill. The first phase is termed the cognitive or early phase. The student has to be able to identify the important cues that have to be attended to. A student in learning to operate a keypunch machine would have to know what the various controls will do and keys are for. The cognitive phase is usually learned through formal instruction. The pupil learns what responses have to be made on appropriate occasions. In learning to keypunch, a student will know the location of the various keys and controls but this will not be enough to make her a skilled keypunch operator.

In the second phase the response has to be chained to the appropriate stimuli. In learning to keypunch a data set, the student must not only see each of the letters or numbers but the striking of each key must become the trigger that initiates the striking of the next key. Wrong habits that are brought to the skill from past experience must be eliminated. The typewriter keyboard is different from that of the keypunch.

In the third phase the skill becomes more automated and automatic. The keypunch operator can keypunch without thinking of where each key is and what finger he should use. An experienced driver can hold a conversation with a passenger while driving down the road.

Educators have been interested in identifying the abilities necessary for the performance of many psychomotor skills. Fleishman (1956) has identified ten such abilities. These are listed in Table 2.

Simpson (1972) reports eleven psychomotor abilities and nine abilities in the area of physical proficiency that appear to account for much of the common variance in psychomotor tasks. These are identified in Table 3.

Table 1

Simpson's Classification of the Psychomotor Domain

Level	Description	Sample Objective
1.0 Perception	First step in becoming aware of objects by use of sense organs	Sensitivity to auditory cues in playing a musical instrument as a member of the group
1.11 Auditory		
1.12 Visual		
1.13 Tactile		Aware of differences in "hand" of various fabrics
1.14 Taste		
1.15 Smell		
1.16 Kinesthetic		
1.1 Sensory Stimulation		
1.2 Cue Selection	Deciding to what cues one must respond to in order to satisfy the particular requirements of task performance	Recognition of operating difficulties with machinery through the sound of the machine in operation
1.3 Translation	Mental process of determining the meaning of cues received for action	Ability to follow a recipe in preparing food
2.0 Set	Readiness for a particular kind of action or set	
2.1 Mental Set		Knowledge of tools appropriate to build a wood cabinet
2.2 Physical Set		Positioning hands preparatory to typing
2.3 Emotional Set		Desire to operate a production drill press with skill

Table 1 (Continued)

Simpson's Classification of the Psychomotor Domain

Level	Description	Sample Objective
3.0 Guided Response	Overt behavioral act of an individual under the guidance of the instructor or in response to self-evaluation where the student has a model or criteria against which he can judge his performance	
3.1 Imitation	execution of an act as a direct response to the perception of another person performing the act	imitation of procedures in threading a sewing machine
3.2 Trial & Error	trying various responses until appropriate response is achieved	discovering the most efficient method of cleaning a room
4.0 Mechanism	learned response has become habitual, learner has confidence and a degree of proficiency in the performance of the act	ability to use a lathe
5.0 Complex Overt Response	individual performs a complex movement pattern skill has been obtained	
5.1 Resolution of Uncertainty	Act is performed without hesitation of the individual to get a mental picture of task sequence	skill in setting up and operating a production bandsaw
5.2 Automatic Performance	Individual performs a finely coordinated motor skill with a great deal of ease and muscle control	skill in tailoring a suit skill in performing on the piano

Table 1 (continued)

Simpson's Classification of the Psychomotor Domain

Level	Description	Sample Objective
6.0 Adaptation	altering motor activities to meet the demands of new problematic situations requiring a physical response	adapting skills developed in using one type of make of equipment to the operation of another type or make
7.0 Origination	creating a new motor act or way of manipulating materials out of understandings, abilities and skills developed in the psychomotor area	creating a new game requiring psychomotor responses

Table 2

Abilities in Motor Learning

Ability	Definition
Reaction Time	The speed individual can make a response to stimuli he is expecting
Tapping Ability	The speed with which an individual can perform a rapid movement
Psychomotor Coordination	Skillful, controlled arm or hand movements at a rapid rate
Finger Dexterity	Rapid manipulation of objects with the fingers
Psychomotor Precision	Involves speed as well as precision similar to finger dexterity but involves more eye-hand coordination
Steadiness	Steady Hand
Motor Kinesthesis	Person maintains upright position in unstable equipment such as simulated cockpit
Aiming or Psychomotor Skills	Skill in performing at high speed tasks such as making dots in circles
Ambidexterity	Skill in performing tasks by either hand

Table 3

Common Psychomotor Abilities

Ability	Description	Experimental Tasks
1) Control Precision	highly controlled muscular adjustments	rotary pursuit control adjustment
2) Multi-limb Coordination	ability to coordinate a number of limbs simultaneously	two-hand pursuit plane control
3) Response Orientation	visual discrimination reaction psychomotor tasks	correct movement in relation to correct stimulus
4) Reaction time	speed with which the individual is able to respond to the stimulus	auditory and visual response tasks
5) speed of arm movement	speed to which an individual can make a gross, discreet arm movement where accuracy is not the requirement	auditory and visual response tasks
6) Rate control	ability to make continuous anticipatory motor adjustments relative to changes in speed and direction of a continuous moving target	motor judgment tasks, rate control, single dimension pursuit
7) Manual Dexterity	directed arm-hand movements in manipulating fairly large objects under speed conditions	Minnesota Rate of Manipulation Test
8) Finger Dexterity	controlled manipulations of tiny objects involving fingers	Purdue Pegboard, O'Connor Finger Dexterity
9) Arm-hand Steadiness	The ability to make precise arm-hand positioning movements where strength and speed are minimized	Tasks requiring holding steady limb positions
10) Wrist-finger Speed	ability to make rapid pendular or rotary wrist movements	rapid tapping
11) Aiming	ability to make movements on target	rapid placement of dots in circle

Of special concern to teachers is the area of skill learning. As in other areas of learning, information feedback in the form of knowledge of results and reinforcement is important. Bilodeau (1966) found that the information feedback cycle in perceptual motor performance involves constant receptor-effector-feedback relationships. Examples of this process can be seen in driving a car. Other typical learning processes are a part of skill learning such as discrimination, short-term memory, etc., so that in the literature very few studies are identified under this category.

In reviewing the literature on skill learning, one topic of interest is the effects of practice. Fleishman (1953) reviews the research on practice and states the following conclusions:

1) as practice continues, changes occur in particular combinations of ability contributing to performance

2) these changes are progressive and systematic and eventually become stabilized

3) verbal and spatial abilities which may play a role early in learning, decreases systematically with practice relative to motor ability

4) there is an increase in a factor specific to the task itself

Travers (1972, p. 210-213) reviews the theory and research on motor skill learning and arrives at the following summary of results:

> "1. Perceptual-motor skills are complex outputs of behavior involved in performing specific tasks. The performance of these skills generally requires that the individual take in information through his sense organs, and the motor skill represents adjustments to the intake of information.

2. Much of the study of motor skills involves the study of the relationship of human inputs to human outputs.
3. Several stages have been identified in the acquisition of motor skills. In the first phase the learner has to recognize the cues he will later use to guide his behavior and the general characteristic of the equipment used in the performance of the motor skill. Thus, the initial phase is a perceptual phase. The second phase is an action phase in which responses come to be triggered by certain cues. Responses have to become tied, not only to whatever external stimuli trigger them (as when one types a letter of the alphabet after seeing the letter on the printed page), but the responses also have to become coordinated to some extent by the responses that preceded them. In the final stage, the responses become almost automatic and are taken over by the lower centers of the brain, and probably particularly those in the cerebellum.
4. In the learning of many skills, a major task of the learner is to overcome the influence of previously learned skills.
5. One of the few motor skills taught in an educational setting that has been extensively studied is typewriting. The early phase of learning this skill takes place largely informally. Instruction usually begins in what Fitts and Posner refer to as the second stage. This stage, in the case of typing, is more complicated than that described by these scientists, in that it involves also verbal behavior which forms an important part of the skill in the early stages of learning. In other words, the learner says to himself the letter he is going to type before he types it. At a later stage, the internal verbal behavior drops out. In the final stage, the typing of sequences of letters takes place immediately and unhesitatingly in response to the perception of the copy being typed. The typist probably runs off sequences of letters, emitting the proper behavior in sequence. It is doubtful, however, whether the response to one letter becomes the stimulus for the response to the next letter.
6. West proposes that typing should be taught with the use of typewriters on which the letters are printed on the keys, although this has not been done in the past. He also suggests that the emphasis should be on speed rather than accuracy.
7. The laboratory tasks most commonly used for the study of motor skills are tracking tasks. Many of these tasks bear a considerable resemblance to tasks undertaken in daily life, such as driving a car, or copying written material. Tracking tasks may be either pursuit tasks or compensatory tasks. These tasks may be varied systematically in difficulty, often by varying the number of dimensions involved and the number of controls that have to be manipulated. Tracking behavior

involves a sequence of decisions followed by actions. In a task involving keeping a pointer in line with a moving dot, the subject will wait until the pointer and the dot become out of alignment and then make a movement to adjust the pointer. The dot and the pointer are kept approximately in line by such sequences of inactivity followed by an adjustive movement. About three such movements per second are commonly made in fast-moving tracking tasks. Tracking behavior is undertaken in small jumps and not in a smooth continuous movement. Supplementary feedback may improve tracking behavior.

8. Perceptual motor skills should be learned in terms of the component skills only when the components do not interact. If the components interact, as they usually do, then the task should be learned as a whole.
9. Performance on most perceptual-motor skills shows a decline after some practice has been undertaken, because of the build-up of inhibitions.
10. The most important single factor with respect to the planning of training in motor skills is control of the rate at which the task is increased in difficulty. The central factor in determining the difficulty of a perceptual-motor task is the rate at which the task provides perceptual information that has to be utilized to perform the task.
11. Some motor skills can be learned, to some degree, through what has been termed mental practice. The extent to which a motor skill can be learned in this way depends upon the extent to which it involves mediating processes. If mental practice is used at all, it should be for very short periods.
12. In the learning of some perceptual-motor skills, knowledge of results or feedback may be delayed for considerable periods, even days, without there being any loss in the resulting learning. Demonstration has some utility in the learning of some skills. The rate at which demonstrations are given is crucial in determining their success.
13. Skills may improve over long periods and there are instances where there have been increments of skill over several years. Even when the person has reached what he believes is his limit of skill, frequent practice is necessary in order for the person to stay at his peak.
14. Stress on the performer is defined as the extent to which he is loaded with, or overloaded with, information from the task itself. Excessive inputs of information to the operator of a piece of equipment produce stress and generally also produce inefficiency. Very low inputs of information also produce inefficiency. Examples of the latter kinds of tasks are vigilance tasks. Perceptual-motor tasks are performed at the peak of efficiency, when the task provides neither a very low nor a very high input of information, but an input at the intermediate level.
15. Motor skills involving continuous tasks are retained, almost without loss, over a period of many years. Discontinuous tasks are less readily retained, perhaps

because they contain more information than continuous tasks, and do not involve as much overlearning.

16. Psychologists have long been interested in the aptitudes involved in the learning of motor skills. Motor ability appears to be fairly complex and involves a number of distinct components. Those that have been identified have been named as reaction time, tapping ability, psychomotor coordination, manual dexterity, finger dexterity, psychomotor precision, steadiness, motor kinesthesis, aiming and ambidexterity."

Modeling or Observational Learning

Modeling or observational learning is quite often observed in the vocational-technical classroom. Modeling or observational learning is the process of acquiring new responses by imitating or simply observing the behavior of another person. The central premise of this technique is that the complex behaviors to be learned can be developed primarily by a combination of components already available in the student's repetoire.

Bandura (1969) emphasizes that learning depends on the students' level of attention to the model and on the degree to which the model's performance makes the characteristics of the behavior to be learned highly discriminable. Reinforcement or feedback plays an indirect role in learning largely through the activation of appropriate attentional and mediation processes. A student's performance is governed by the laws of reinforcement because the student is more likely to perform the new behavior because he is reinforced by doing it.

Much research has been conducted on the acquisition of social rather than cognitive or psychomotor learning. Sullivan (1967) found that viewing of films of adults conserving liquid and substance improved conservation performance of first graders. Modeling procedures were used by McDonald and Allen (1969) to train teachers in skills that combine significant social and cognitive behaviors. They demonstrated that by

using video-taped models of effective teaching behaviors they could enhance the acquisition of these in the trainee. The model's effectiveness was greatest when the trainees viewed the video-tape along with the experimenter who pointed out both the appropriate behaviors of the model and the occasions suitable for these behaviors.

Use of Instructional Media

There has been much research to match media and student characteristics and to see what media mode is best to present certain types of learning. Householder (1968) stated, however, that research in the applications of instructional media has not yet been successful in identifying principles or generalizations of value to practitioners in vocational, technical and practical arts education. He concludes that in many instances, research evidence is contradictory or at best inconclusive with regard to the effectiveness of various media for instructional use in the vocational-technical field.

Briggs (1970, p. 95) summarizes the research on matching media and characteristics of the individual:

> "In general, if the learner is a poor reader, he will, of course, do better hearing spoken words than reading written words. Young children will do better by demonstrations using actual objects they can see, feel, and watch being manipulated, while older students may learn just as well by a verbal description. Pictures may be more useful for the young or the poor reader than for the mature adult. In fact, for the well-educated adult, reading is usually as effective as listening or seeing pictures for most subject matter not highly dependent upon pictorial display. Passive, submissive children may do better by programmed instruction or independent children may do better by programmed instruction or self-directed study or contract teaching from a variety of materials. Books permit backtracking easily to catch a missed point, but this is not readily possible with films, tape recordings, or teaching machines.

> Pictures may be better than words for certain students. For low-ability students or for difficult material, programmed instruction is usually superior to regular printed text (Briggs, 1968a). Large steps can be taken by bright mature, independent learners; small steps may be needed for converse learner characteristics. Findings disagree as to whether the learner can select the media and materials best for him. Rebellious students, and those motivated to avoid failure, do best by a highly structured, authoritarian mode of instruction; students motivated to achieve success do better by more unstructured, permissive conditions. Dependent students may learn by film; independent students by reading or lecturing."

In this review research and application will be focused primarily on the use of motion pictures, video-taped recordings, and multi-media presentations. Research and application of programmed instruction, CAI , or other minor modes will not be discussed.

Motion Pictures

Films have many features of other media such as presenting printed words, drawings and still pictures but have the extra advantage of showing actions and objects in motion. The normal time-place relationships can be accelerated or slowed down which can help to indicate better the relationships of objects and events or correlation of action effects. Sound motion pictures can present many auditory and visual stimuli which cannot be presented by a teacher, book, computer or programmed instruction.

Films can be shown to large groups as well as to individuals if space arrangements are available. One deficiency in the use of films is that they do not require students to make explicit overt responses or provide explicit feedback to the student.

Moeller's studies(1967, 1968) found that films were not a substitute for individual demonstrations but are a supplement to a well-integrated instructional program. He experimented with groups being trained to work with metal and engine lathes and used 8mm films and synchronized tape.

Somme (1970) found that in teaching vocational skills by the use of single-concept film loops that the teacher plus film was more effective than teacher only or films only. Secondly, the film-only group learned as much as the teacher only group. Thirdly, the repetition of demonstrations was substantially reduced with films and lastly, boys and girls did not differ significantly on any of the measures.

Television-Video Tape

Instructional television and the video-tape recorder have many of the advantages of the motion picture. Quick playback is possible with VTR. The VTR has been used extensively in micro-teaching and critiquing of performance situations.

Chu and Schramm (1967) surveyed 421 studies comparing instructional television with traditional teacher instruction and found no significant differences in 308 comparisons. Instructional television was more effective in 63 studies; teacher instruction in 50.

Dubin and Hedley (1969) analyzed the effectiveness of instructional television at the college level and reported 191 comparisons in which 102 favored instructional television and 89 favored teacher instruction.

Jamison (1974) states that instructional television can teach all grade levels and subject matters about as well as teacher instruction though some evidence indicates that it performs relatively better at lower grade levels. He also points out that a significant fraction of teachers and students have initially negative attitudes toward instructional television which tend to lessen not necessarily disappear.

Stout (1963) used instructor-operated educational television to teach topics in mathematics, physics and slide rule operation without a production staff. The instructor operated the whole system. He concluded that: 1) the uses of an educational television program depends upon thoughtful and detailed planning; 2) educational television systems need not always use sophisticated equipment; 3) the maintenance costs can be kept low; 4) low-cost, fixed camera TV seems feasible if at least 50 additional students can be taught with the system; 5) there should not be students in the room from which the program is emanating; and 6) students learn mathematics, slide rule, general physics and electron theory as well as by having the instructor in the room.

The video tape recorder for micro-teaching has been successfully used in the education of teachers for the vocational-technical field.

Multi-media

Filmstrips, slides, and audio-tapes have also been used for vocational-technical instruction. Shemick (1965) taught metal spinning by the use of 35mm slides and tape cartridge. The subjects needed fewer assists by the instructor to produce a spun aluminum bowl, but took more time and trials and did not attain the performance quality exhibited by subjects who observed a demonstration.

In using media in instruction Briggs (1970) states the teaching functions should include:

1) providing an introduction and transition
2) providing a reason to learn (motivation)
3) presenting the stimulus;problem, topic, content
4) giving directions as to how to proceed

5) directing attention: "look at this part"

6) providing a model or description of expected performance

7) providing feedback

8) conducting appraisals or evaluation

The steps to be included in media selection are listed in Table 4.

Table 4

Summary of Steps in Media Selection

Step	Description
1	Define the boundary conditions
2	Decide between individual and group instruction.
3	Identify the characteristics of the learners.
4	Identify a competency to be analyzed.
5	List the general instructional events to be used.
6	List the special instructional events.
7	Arrange the entire list of events in the desired order.
8	List the type of stimuli for each event.
9	List the alternate media.
10	Make a tentative media selection.
11	Review an entire series of tentative media choices.
12	Make final media choices for package units.
13	Write a prescription to the specialist for each package unit.
14	Write a prescription for the teacher.

II. Principles of Learning and Instruction

1. Principles Related to Motivation

1.1 Motivation is the internal process within the learner which functions to arouse, sustain, and direct the behavior of the learner as well as the intensity of his effort to learn. A teacher does not create motives in children, rather they are already present in the learner. The teacher's task is to identify and nurture the unique motives of each child to determine what it is that drives him, interests him or entices his curiosity about the learning process. The learner must want to learn for whatever reason may be motivating him. Learning does not occur simply by forced repetition of an act or by osmosis resulting from mere exposure to a situation. Something must motivate him to activate his goal-seeking tendencies. Perhaps he has developed an interest in the activity or topic because of previous pleasant experiences with it, perhaps he chooses to learn to win praise from his parents or teachers or avoid their criticisms; perhaps he wants to out-perform a classmate or to win friends by his accomplishments; these specific conditions which activate a goal seeking tendency in the learner are generally referred to as motivational conditions.

A. Learning increases with increased motivation up to a certain point. This generalization is especially true when the learner is working on a task well within his potential ability. Most of the evidence shows some increase in performance with initial increments of motivation.

B. Maximum gain in learning occurs when there is a moderate degree of motivation. Mild forms of motivation result in performance distinctly above that for no motivation, but strong motivation results in performance only a little better than that for mild motivation. In other words, there seems to be a negatively accelerated curve of increments in learning for equal increments in motivation.

C. The point at which maximum gain in learning will be reached depends upon: (a) the complexity of the problem, strong motivation having a positive effect on the solution of easy problems and a negative effect on the solution of complex ones; (b) the ability of the learner, motivation having a greater effect on those who have much ability in relation to the task; (c) the degree of concentration of the motivation, that which is presented in a number of small allotments being more effective than that concentrated in a single intense incentive; and (d) the susceptibility of the learner to motivation, that is, his tolerance for emotional stress.

D. When tension increases beyond the optimal point, learning is disrupted. In some cases the effect is satiation so that the learner no longer responds to the incentive. In some cases freezing or rigidity occurs. In other cases irrelevant actions for tension release take place. In extreme cases agression against others may occur as a form of tension release.

E. An increase in the degree of motivation increases the variability in a group. Individuals differ more widely in their reactions under strong motivation than under mild motivation.

F. Altogether, moderate levels of motivation result in the greatest efficiency in learning, especially in problem solving. When motivation is very low, the learner is easily diverted by extraneous factors and behavior tends to deteriorate into a series of acts that are not goal-directed. The effect of strong motivation is to decrease the quality of the work done and to increase the activity level. Under intense motivation the learner concentrates narrowly on the goal to the exclusion of features of the situation which are essential to the solution of complex problems. Moderate tension facilitates learning. The most effective motivational level lies somewhere between no motivation and intense motivation.

1.2 Level of Challenge

A. The most effective effort is put forth by students when they attempt tasks which fall in the "range of challenge"--not too easy and not too hard--where success seems quite possible but not certain.

B. According to some studies, many pupils experience so much criticism, failure, and discouragement in school that their self-confidence, level of aspiration, and sense of worth are damaged.

1.3 A Summary of Implications of Motivation for the Classroom

A. Avoid over-motivation through too great intensity or too frequent repetition of a given form. Increase motivation gradually. Turn to other motivations before there are signs of disturbance such as turning away from the activity, freezing, excitement, or agression. Discontinue motivation if there is any sign that learning is disrupted.

B. Help students to set their own standards for accomplishment. Avoid imposing goals that are foreign to them. Avoid adding to a strong self-imposed motivation.

C. Help students set realistic goals for themselves. Help the child to know his abilities so that he may choose goals wisely. Individualize goals wherever possible. Dignify all goals so that each can retain self-respect.

D. Help students meet the goals they have set. Prevent failure by helping in the selection of suitable goals. Build self-respect whatever the achievement may be.

2. Principles Related to Instructional Methods and Teaching Strategies

The techniques which the teacher selects to direct and manage the learning process are critical determinants of the final outcomes of learning.

2.1 Using Behavioral Objectives

Stating a desired outcome in specified behavioral terms not only points out directions which the student must take, but also provides criteria for evaluating the extent to which the student has learned the task. In the case of learning in the vocational-technical educational setting an instructional objective might be comprised of skill statements which describe motor acts or outcomes necessary to perform the task efficiently. The following is an illustration of a stated instructional objective for an automotive repair class: The student will replace a set of spark plugs in an automobile engine. The spark

plug gap will be adjusted to specifications as per Motor's Manual, and demonstration, using a spark plug gauge, and spark plug socket. The minimal performance is that the car will run and they are torqued (plugs) will show 15-20 lbs. of force when checked by the instructor with a torque wrench.

2.2 Reinforcement, Feedback and Knowledge of Results

A. Behaviors which are rewarded (reinforced)are more likely to be emitted.

B. Sheer repetition without indications of improvement or any kind of reinforcement is a poor way to attempt to learn.

C. Threat and punishment have variable and uncertain effects upon learning; they may make the punished response more likely or less likely to recur; they may set up avoidance tendencies which prevent further learning.

D. Reward (reinforcement), to be most effective in learning, must follow almost immediately after the desired behavior and be clearly connected with that behavior in the mind of the learner. It is generally found that positive reinforcements (rewards, successes) are to be preferred to negative reinforcements (punishments, failures). (See H below)

E. Association with some kind of feeling tone, whether pleasant or unpleasant, aids learning and recall. It is the emotionally colorless experience that is most difficult to remember, both immediately and later on. Both positive and negative reinforcement facilitate remembering. If a skill or attitude or other learning is to become permanent, some comment or some consequence with emotional overtones is desirable. The least favorable condition for remembering is to have an action ignored. The presence of emotion helps to isolate the learning cues. It is better for the teacher to say something than to say nothing if she wishes the child to learn from his experience.

F. Conversely, ignoring a response helps the learner to forget it. Sometimes the forgetting is what the teacher wants. If the student makes a mistake, whether in spelling or in playground behavior, a neutral or indifferent response or no reaction at all is the best way to avoid recurrence of acts that are not habitual. The teacher should ignore the behavior she wants the individual to forget.

G. Negative forms of reinforcement should be used only for learnings the teacher wants the student to remember to avoid, not for those she wants him to forget. There are occasionally dangerous acts, or fixed habits that the teacher must bring to attention in order that they be eliminated. This need applies to relatively few situations during the initial stages of learning. The learner may respond to negative reinforcement by learning not to give a punished response, or by learning to do something to avoid the school situation. The danger in using frequent or intense negative reinforcement is that the anxiety it produces is likely to generalize to related parts of the learning situations which the teacher does not want the learner to avoid; for example, too much reproof for poor handwriting may make the learner avoid all forms of written expression. Negative reinforcement generalizes more widely than positive forms.

H. In the long run, positive forms of reinforcement facilitate learning more than negative forms. When praise is repeated a number of times, the learning increases for an initial series of trials, then levels off, eventually the learner becomes accoustomed to or dependent upon praise to maintain his own feeling of self-worth. With reprimand or failure, learning is increased immediately but falls off very soon and very rapidly; failure does not maintain its effect in stimulating learning as long or as well as praise.

I. Pronounced differences in attitude occur under positive and negative forms of reinforcement. When the pupil feels he is succeeding, time seems short, the task seems easy, he enjoys what he is doing, and he is more likely to resume work after interruption. When he feels that he is failing, time seems long, the task seems difficult, he dislikes what he is doing, and he is less likely to come back to the task. When succeeding, there

is an increased activity level, greater effectiveness of work, more recall of related material, more language expression, and a longer period devoted to the initial effort. When he is failing, he becomes passive, forgets related things, and tires quickly. Students seek again those experiences in which they have succeeded and avoid those in which they have failed, but they remember both.

J. Both positive and negative reinforcement are most effective when attached to specific acts rather than to diffuse situations. This difference is, in part, due to the stronger focusing of the motivation on the behavior in question.

K. Symbolic forms of reinforcement are effective, though non-verbal forms are more effective than verbal forms. Actual success is superior to praise by the teacher, perhaps because the success communicates more effectively a feeling of self-worth than does a comment from an adult. Arranging situations in which the learner can succeed, and permitting him to experience the normal consequences of acts in which the teacher feels he has failed, are the most effective forms of motivation.

L. Both positive and negative forms of reinforcement are best used immediately after or as part of the learning experience itself. Delayed praise or reprimand, unless they are anticipated, will have relatively less effect on learning than either given immediately. An anticipated reward is about as effective as a reward given immediately, but threatened punishment is less effective than immediate negative reinforcement. The effect of the delay follows the same pattern as that for repeated use of the reinforcer; that is, the positive form maintains its effectiveness longer than the negative.

M. Both pleasant and unpleasant feeling tone recede toward a neutral value with the passage of time. The process of forgetting, of overlaying old experiences with new ones, operates in feeling tone as it does in more largely intellectual areas. But what we recall as pleasant in meaning is sometimes different from what we experienced as pleasant in feeling at the time. An operation or an accident may have been an unpleasant as an experience, but recalling our fortitude or heroism at the time may be highly pleasant. There is some indication that over long time intervals we avoid recalling unpleasant experiences that remain unpleasant to recall, but retain the ability to recall pleasant experiences that are pleasant to recall.

N. Both positive and negative forms of reinforcement are best used in moderation, and with frequent shifting in specific form. Any form loses its value if repeated often. The balance, however, should be on the positive side in the long run in order to help the pupil maintain his self-respect and a feeling of adequacy.

O. Individual differences in reaction to positive and negative reinforcement are significant. Negative forms are felt earlier than pleasant. Bright students and those whose initial standing is high can respond more constructively to negative forms than slow-learning ones; the slow-learning need constant praise and they respond to rewards in a relatively greater degree than do the bright. Boys seem to be able to respond to negative forms more constructively than girls, perhaps because our culture protects girls. Older children respond to both positive and negative reinforcement more strongly than younger children, and are able to use negative forms more constructively. Praise is especially important in the preschool and primary years. Well-adjusted children have histories in which positive forms of reinforcement have predominated, while poorly adjusted children have had a high proportion of negative reinforcement, creating insecurity. Introverts respond best to praise, particularly to continue praise; extroverts can use reprimand constructively. Some teachers, and all teachers in some situations, can use praise more effectively than reprimand; for others the situation is reversed.

P. Practice without knowledge of results brings little or no improvement. In the beginning, there may be some increase in motor adaptation in a simple skill, but no sustained progress is apparent. There is slight evidence of latent learning, that is, of improvement which shows up under motivation after initial learning is completed. For the most part, practice is only a time framework within which other factors may operate; practice alone accomplishes little.

Q. Knowledge of results brings marked improvement in performance. Evaluation is not merely a method of measuring teaching outcomes but is also an integral part of the teaching process itself. When a student is given knowledge of results after working without knowledge of his progress, his learning curve shows a decided upward trend.

R. The more detailed and specific the knowledge of results, the greater the progress. The learner needs to know not only whether he has achieved his goal but also how far from the goal he was and in what direction he deviated. Evaluation should be specific. Partial knowledge is better than no knowledge at all, but full knowledge is most effective.

S. The more positive the knowledge of results, the greater the progress. The reason for this conclusion may lie in the fact that knowing a given response is right is more specific than knowing a particular answer is wrong. Pointing out errors is less effective than pointing out correct responses, especially where the emotional content in the learning is moderate and any hint of punishment or reward is avoided. The effect of emphasizing the right response is that the learner's errors drop out. The effect of emphasizing errors is that he still makes them but turns back quickly, a more roundabout method of meeting the situation. Pointing out errors makes the child remember the error but not its correction.

T. Immediate knowledge of results is superior to delayed knowledge. And the superior performance gained under knowledge of results persists after the giving of objective information is stopped.

U. Classes and individuals differ in the way in which they respond to knowledge of results. Young children seem to be affected more than older. Better students are affected most, whereas poor students are affected little. The degree of effectiveness of any incentive varies with the learner's estimate of his possibility of success in that situation. Further, the level of interest for the particular learner and the particular activity will affect the amount of gain from information about results.

The implications of these facts for teaching about results and for most effective learning, knowledge of results should be introduced as quickly as possible and in as specific a form as possible. This fact probably largely explains both the efficiency of individual instruction and the inadequacy of imprecise letter and number grades. The information given, however, must be relevant to some motive of the student.

V. Success and Failure. Success is often an end in itself. It is a type of reward. Both success and failure promote learning. If failure comes too soon or too frequently, the learner may become discouraged. His negative attitudes and discouragement may lead to emotional disturbance. All of these may interfere with his learning. If he sees himself as likely to fail, this view of himself must be altered before he is motivated to learn. Ordinarily we use our failures to improve our performance. When goals are attainable and clearly defined, success is more probable.

Studies of the effect of failure seem to show that failure is not comparable to success in the sense of being its opposite but that instead, the effects of failure differ in quality. Specifically:

1. Failure depresses the action potential. Muscular action normally accompanies attempted solution of problems. There is usually a decreased motility level under failure. Sometimes there is speeding up to relieve tension at the expense of efficiency of work. Sometimes "sparking-over"to activities not directed to learning occurs.

2. Failure slows learning. It decreases the number of correct responses and increases the time taken to give them. It results in apathy or depressed psychological functioning as a defense against complete awareness of failure. It means a decreased sensitivity to potentially disturbing stimuli, both internal and external.

3. Failure causes a moving away from reality. Quitting, day-dreaming, and regression are common. Social responsiveness is reduced. Work is dogged and ineffectual. The task also is decontextualized, or split off from its social frame of reference.

4. Failure causes persistent nonadjustive behavior, and tends to fix incorrect response patterns. Frequent punishment of the wrong response is more likely to cause the response to occur again than to eliminate it. This response is especially probable if the pupil knows he is wrong but does not know what is right. Reprimand also strengthens the response by serving as an informative signal.

5. Failure increases the variability of behavior. Some students show aggression, others regression, some respond with skepticism and some with panic. Some do the same thing over and over mechanically; others "freeze." The effect of failure seems to be intensified whatever response pattern is dominant in the pupil at the moment. Individual differences increase under failure, decrease with success.

6. The effect of failure is cumulative. We have already noted that repeated failure is damaging, and that anticipated failure interferes with learning. There is greater danger of over-motivation and disruption of learning in failure than in success.

7. Failure causes changes in attitudes as well as in ability to remember. It shortens the pupil's time perspective, makes him think of the minutes spent in learning as long, of the learning as difficult and unpleasant. It makes him forget related material he previously knew. The relation of these facts to non-promotion is of interest.

8. Training can correct these ineffective behaviors by introducing progressively more difficult tasks in which the child succeeds. With success comes interest, self-direction, and elimination of non-adjustive behavior. For example, trial promotions result in as much learning as non-promotions, and grades in new subjects tend to be higher than those in repeated subjects.

2.3 Transfer of Training

Transfer of training is an important factor in learning. The experiences provided by any school today are based on the assumption that there is such a thing as transfer of training. It is commonly believed that there is sufficient similarity between experiences so that preparation for one experience will:

1. prepare the student for that experience
2. prepare the student for many similar experiences

An examination of the aims of any school program will demonstrate that transfer is expected to accomplish many of the aims. A goal such as teaching children to think is designed with the anticipation that if they develop this skill in school, they will be able to use this skill outside of school and in later life in dealing with problems.

Teaching for transfer must be one of the aims of teaching. If the lesson never reaches the stage of generalizations, there will be no transfer. Instead, the learning will consist of facts and details with very limited application outside the particular situation.

Students should be provided with opportunities in which they can discover generalizations. Generalizations which are independently discovered will be retained longer and applied more widely.

Assuring that the material is meaningful to the student will enhance the opportunity for transfer. It is important that the student be aware of the purpose of learning. This would include an awareness of its immediate purpose as well as potential purpose in other school and non-school situations. Pointing out the possibility of transfer of learning from one situation to another should occur at every opportunity. This teaches the student to be on the lookout for transfer situations. Select instructional materials which are appropriate for making relationships vividly apparent. The use of a number of examples of applications of principles when teaching concepts of a broad and abstract nature will make the situation more meaningful and less likely to result in meaningless verbalism.

a. Make situations discussed and activities conducted in the classroom as similar as possible to those which the student encounters outside it.

Examples: In business classes make the classroom as much like an office as possible. In auto shop make the class as much like a garage as possible. Use student body and class elections to teach students how to function as voting citizens.

b. Positive transfer occurs whenever a specific response already learned is to be made in a similar new situation. This is the theory of identical elements. There may be partial identity of content, or the use of a common method. A spelling word learned in writing a story is likely to be spelled correctly in a letter. A word learned in the reading of one page is usually recognized in a different context. A word element which is constant for a group of words may be pointed out and new words worked out more easily as a result. Training in memorizing poetry will help the learner to memorize new poems.

c. Positive transfer occurs whenever a generalization already learned applies in a new situation. An attitude toward arithmetic formed in the third grade may affect a woman's ability to balance her checkbook. Experience in logical reasoning gained in geometry may under favorable conditions carry over later to estimating heights. A study procedure learned in history may carry over later to economics. General principles, modes of attack, and sets to perform are the most common transfer agents. The process of learning is one of taking specifics and gradually developing concepts from them, as we have seen in our study of problem solving. The process of transfer reverses the process, taking concepts previously

learned and applying them to new situations. Both learning and transfer are essentially dynamic processes in which the individual reconstructs and modifies his behavior and creates new patterns of action on the basis of the old.

d. Positive transfer is more likely to occur when there is conscious teaching for transfer. Transfer is not automatic. For transfer, the material must be taught not as a specific, but for broader use. Wide experience and factual knowledge do not assure transfer. Transfer is the result of conscious effort, of conscious generalization and application while learning.

Transfer is favored by a learning set directed toward classification generalization, relationships, and position within a logical learning structure. It is much less likely to occur when generalization is undirected, and when the relationship to other learnings is a mechanical one.

The teacher may aid transfer by suggesting that certain experiences may be useful, proposing a method of study, providing knowledge of related fields, encouraging the development of skill in manipulating ideas, stimulating systematic questioning of the evidence, teaching the ability to apply statistical analysis and interference, and making the individual aware of methods he is using and might use. The ability to organize materials and methods to promote the maximum degree of positive transfer is the mark of a superior teacher. The learner will transfer to some extent on his own initiative when two situations are highly similar, but conscious teaching for transfer will make it possible for the individual to apply his learning more widely through analysis of similarities between the old and the new. Ability to transfer is an important factor in perception, insight, reasoning and originality.

e. The more effective the original teaching, the greater the degree of transfer. Transfer is more likely to occur when the original learning is complete and accurate, when the materials are meaningful and structured, when the transfer situation is highly similar to the learning situation, when the material provides for continuous reconstruction of experience, when the attitudes toward learning both the original and the transferred materials are favorable, and when the time between original learning and transfer is relatively short.

f. Individual differences are apparent in the ability to transfer. Bright students and older ones generalize easily; hence, they are able to transfer their learnings more widely. In general, how much transfer occurs for a given individual depends on the material to be learned, his experience, his desire to learn, and his training in generalization and transfer procedures.

g. A summary of implications for the classroom are:

1. Point out the possibility of transfer. If pupils expect that what they learn will help in later situations, they are most likely to use it when opportunity arises. The teacher can introduce specific materials illustrating life situations where the principles of the school subject are applicable: shortcut calculations based on algebra, hidden assumptions in the reasoning of advertisements for comparison with geometric postulates, and habits of dental care as an application of knowledge about bacteria. Instances of confusingly similar situations may be specifically pointed out to reduce negative transfer.

2. Use varied teaching materials, like those to which the learning is expected to transfer. Beyond merely pointing out situations to which learning may transfer, the teacher should base the classroom work on life-like materials whenever possible. The more a pupil experiences the real situation, the more likely he is to recognize his next opportunity to respond to it. This principle is illustrated in the gradual reduction of verbalism in the schools, exercises with words being replaced by exercises with objects, charts, and motion pictures. The experience of conducting a student-body election has more in common with the experience of a citizen than does memorizing the life history of a bill introduced in Congress. The class which experiments on white rats learns more about the effect of nutrition on growth than the class which merely learns the verbal principles.

3. Develop meaningful generalizations. Each classroom topic can be thought of as something to be learned in itself or as an illustration of a broad principle. One may memorize Caesar's biography, or one may observe in it the consequences of concentrated power. One may learn how the gasoline engine operates, or one may derive from it principles applicable to all thermo-dynamic systems. One may do an arithmetic problem, or one may learn from it a general plan for all problem-solving. It is these broader principles which make a particular learning most widely transferable. It is not enough, however, to present generalizations. They must be understood by the learner, not merely parroted.

4. Provide practice in applying the generalization. An essential stage in transfer is recognizing a new situation as a special case of an old type. One cannot practice such recognition by drilling on a page of exercises, all of one labelled type. Practice is obtained by encountering a new situation in a setting which does not carry a sign identifying the generalization to be used. Some of the best experiences for transfer come through encountering algebra in the science text or science in the home economics project. Any teacher can set up transfer experiences by introducing problems calling for application of generalizations in a context which forces the student to decide for himself what procedures or principles apply.

5. Evaluate the learning experience by determining how the pupil's behavior in new situations is changed. Such evaluation stresses for the pupil that learning goes beyond memorizing and points out for the teacher his achievements and failures. In the long run transfer has reduced to a special case of the problem of learning. One learns the responses one practices, if that response has satisfying consequences.

2.4 Distribution of Practice

The teacher often wonders whether to go on working with a process until it is mastered. If the process is to be broken, at what point should the break occur? What should be done during the rest period when reminiscence is presumably occuring? How often and for how long should she come back for overlearning? A spelling word is mastered one day; the teacher must decide whether to introduce it again and if so, when. The same dilemma occurs in teaching word recognition, arithmetic facts, and other skills.

Investigations of distribution of practice are among the earliest studeis of learning. Most experimentation has been done in laboratories. A few attempts have been made to apply the concept of such practical problems as frequency of class meetings, memorizing poetry and prose, learning codes, and learning piano.

The experimental work on distribution of practice shows that:

a. Distributed practice is uniformly superior to massed practice. With the amount of time or the number of trials held constant, the efficiency of learning is inversely proportional to the degree of massing and directly proportional to the degree of distribution of practice. The reason for the superiority of distributed practice may be the effect of fatigue in massing, practice in warm-up in distributed practice, differential forgetting during rest in distributed practice, maturation of learning during rest, or more persistent motivation and higher morale in distributed learning. There seems to be a rhythm, alternation, or periodicity of action to which distributed practice conforms and which makes it superior.

b. Practice periods of decreasing length and rest periods of increasing length represent optimal distribution. We have already seen that a presentation should be long enough to assure mastery of the concept, and that practicing beyond that point is harmful. Now we find that relatively short practice periods, decreasing in length, are best. Bringing the material to attention repeatedly is more important than holding it in attention for long periods of time.

As for the rest periods, they should be of medium duration since periods that are too short do not permit reminiscence or forgetting to take place, and those that are too long have no advantage since the greatest forgetting and reminiscence take place just after learning stops. The best point at which to introduce the first rest period corresponds to the point at which reminiscence becomes effective, somewhere between the point at which learning is half complete and where it is just complete.

In any event, the length of practice period and length of rest period must be adjusted to each other. In the most effective schedule, the periods are first long and close together and then become increasingly short and widely spread.

c. The minimum length of practice period depends upon the nature of the material being learned. Materials that are highly structured and meaningful, and are approached in a logical manner, can profit from more massing than material that is relatively meaningless. Where there are large elements of discovery, as in problem solving, and where variability of attack in the early stages of learning is important, the initial units may also be relatively long; on the other hand, when the learning is routine or drill in nature, long and difficult, presented rapidly, or where the learner is limited in ability, distributed learning is superior to massed learning . In other words, distribution of practice is particularly important for learning that is difficult and tedious.

d. The advantage of distributed practice is greatest in delayed recall. We have seen that the reminiscence effect is a temporary phenomenon, affecting immediate rather than delayed recall, and that the effect of overlearning is greatest in permanent retention. Now we see that if we pause for a little while, then present the material again, we have the advantage of both processes.

2.5 Part vs. Whole Learning

This practice refers to the superiority of learning a unit of material as a whole over learning it by parts and combining the parts later. Earlier research studies were much more conclusive than recent studies have been. In research studies many of the conditions are difficult to keep constant. As a result, the experiment is often, in terms of results, spoiled or inaccurate. This is properly contamination of the experiment. In other words, we are likely to give the credit to one method, whereas the nature of the material or the attitude of the learner is the factor that caused the difference in results. The main problem is the definition of whole and part. If the material is unified, functional, and consists of a meaningful unit, learning it as a whole is recommended. For example, a poem which contains a single thought or is narrative in nature is probably best learned in whole. For some tasks, effective performance will require a mastery of separate parts of the task which must precede putting them together as a functional activity. For example, in performing a complex machine operation it is very often necessary to break it down into its component parts to learn it. When the separate actions are learned they are put together to make a total performance.

The capacity of the learner and the nature of the task seem to be important variables. Several principles seem to apply to this problem:

a. Learning should be undertaken by using the largest units that are meaningful and within the capacity of the learner.

b. Becoming familiar with the overall organization, or previewing the total operation, will help to make the learning of contributing parts more effective.

c. Some form of part method is usually preferred by the learner. The smaller unit requires less initial effort for learning. In addition, the learner experiences a feeling of success each time he masters a part, and the total of the success experiences for many parts is greater than the single feeling of success he achieves in working from the beginning with the whole material. Part learning shows rapid initial learning of the parts themselves, but does not transfer to the whole.

d. Units should be clearly and simply structured or patterned. Learning is not a process of reproducing what is presented, but one of invention and reconstruction -- of understanding whole qualities through improved organization of the material. Difficulty in learning is a function of the amount of re-forming or structuring that the material requires to become meaningful to the learner. The concept of what constitutes a whole is a relative rather than an absolute one. A whole for a given child depends upon his purpose in learning, his maturity, the meaningfulness of the material to him, the closeness of logical relationships or continuity within the unit, and the situation in which the learning will ultimately be used. Whole presentation is superior especially for bright students. It has an advantage in creating interest, in transferring to new situations,

and in long-term retention. It favors understanding and carries the benefits that accompany understanding.

e. Where the unit is structured but overcomplex for the learner, it is best to present the major outline, then isolate one part for attention, then fit it back into the unit within the same learning situation. If the learning must ultimately be used in the context of the whole, too complete learning of parts may inhibit later learning of the whole; part learning does not transfer automatically to the whole. It is well to begin by doing the thing in the way in which it is eventually to be done, but in major outline uncomplicated by too many details; then to isolate each part for special attention; then to link the parts back to the whole structure.

The learner himself should help in structuring and organizing the materials, selecting problems and evolving plans, solution and evaluation. If he gains the idea of the pattern of the whole, he will fill in the appropriate parts. For example, a student in writing a story needs a word he cannot spell: the teacher shows him how to write it; he uses it and goes on with the story. Later he places that word on his spelling list and studies it: isolation of the part is helpful in mastery. Still later he needs the word again in writing stories, and either recalls or looks it up and writes it again until he recalls it.

f. Conversely, where there is no inherent connection between learnings, they should be taught as independent units. It is most effective to teach together, to teach separately those things that do not belong together. Teachers sometimes think that everything they do should be fitted into a major unit of work, but find that such things as holidays or some aspects of arithmetic do not fit in. Independent minor units should be devised for such needed learnings, but without forcing the relationship. Wherever the material to be learned resists

organization because it is of unequal difficulty or irregular in nature and must remain relatively meaningless or "blind" or where it is very long, part learning is about as effective as whole learning. Where two or more small units exist, with stronger internal relations than the ties between them, teaching them separately (that is, following the structure of each unit) will be superior. There is no merit in grouping unrelated units together.

2.6 Activity vs. Passivity During Learning

a. The more active the participation of the learner, the more effective the learning. Attempted recall or recall with self-prompting results in better learning than simply rereading the same material. Re-presentation without recall is consistently ineffective, particularly in retention.

Reading followed by taking a test results in more learning than covering the same material without test. The attempted recall aids learning. Written examinations are more effective than oral because of the more intensive use of the time of each individual.

Laboratory experimentation is superior to lecture-demonstration in effectiveness. Lecture-demonstration is superior to discussion or lecture-discussion for college and high-school students. Discussion is superior to lecture; and lecture is superior to reading for the average student. This order holds true for facts gained, understanding of principles, and resourcefulness in problem solving. The greater the degree of student activity, the more the learning.

Note-taking aids recall because the student does something about what he hears. The more clear, full, and definite his notes, the more gain there is from note taking. Verbatim notes are less helpful than summaries. Being on the alert for information, asking questions, taking tests, and marking one's own paper all produce better learning

than listening passively to what is presented.

Amount of effort is positively related to the amount learned and retained. In addition, the individual who participates actively develops greater interest in what he is learning even though his grades may not improve. All these findings point to the fact that we learn and recall only that to which we respond and in the degree to which we respond. We do not remember the stimulus but rather what we did in response to the stimulus.

b. The greater the proportion of time given to active response, the greater the learning. The limit is that the initial presentation must be long enough for full presentation of the "whole"; it must permit giving the outline of what is to be learned. Within that limit, the earlier attempted recall is introduced and the more frequently it is used, the more effective the learning.

c. Individual differences occur in the effectiveness of overt activity in learning. Young children gain more from activity and attempted recall than older, and their activity is essentially overt rather than symbolic or mental. They have fewer concepts with which to work and possess a shorter attention span. Similarly, bright students can work more easily with symbols, and can learn more easily from reading and lecture. Activity is especially helpful in the learning of material that is essentially meaningless and unconnected, since there are fewer other cues to aid in learning.

Essentially, then, we learn through what we do and not through what is done to us. We remember our own responses, not the stimuli. Students are more willing to part with their texts than with their term papers when time for housecleaning arrives. The axiom that we love people less for the good they have done us than for the good we have done them is a statement of the same principle. Interest in

manipulation or in activity seems to be a basic human tendency, and the teaching which takes that tendency into consideration is more effective than that which considers learning to be a passive assimilative process.

2.7 Use of Demonstration and Guidance Activities in Teaching

a. Demonstration. The essential purpose of the initial stages of instruction is to give the learner a clear idea of what he must try to do. If verbal explanation and directions are not sufficient to accomplish this, the instructor must show the learner. Because a young child is less capable of strict attention than a mature person and since his ability to comprehend and remember what he is told is more restricted, he more often than an adult, will need to be taught by means of demonstration. Lack of attention can be as much a result of incomplete understanding as a cause of it.

In giving a demonstration of the performance to be learned, the instructur must take care that his pupil is in a position to observe the essential details of the demonstration and that his attention is being given to it. It must not be hurried but should be given slowly enough for each step to be witnessed and understood. In the case of a demonstration involving several steps, it may be necessary to repeat it several times. In most cases, explanation should accompany the demonstration.

Common mistakes of an inexperienced teacher are to cover too many details in a single explanation, to give too many directions all at once, or to demonstrate more than a beginner can possibly assimilate at one time. The instructor should remember that the role of his instruction is to establish a set in the mind of the learner - a task - and that the capacity of any person is limited with respect to the

number of steps that can be incorporated into a single task. It is poor teaching , for example, to take a young person out for his first lesson in driving a car, and proceed to tell him all you know about handling a car. He will not be able to remember more than four or five items of instruction at a time. The complex processes must be taken up a few steps at a time. As these are practiced and mastered, new steps can be added and the whole process integrated by practicing all the steps together.

b. Degree of Guidance. The teacher must decide, too, when to help a student and when to let him work out a problem for himself, when to answer a question and when to lead him to find his own answers, and when to give no answer at all. In psychological terms, we are speaking of "degree of guidance." This scientific use of the term is to be distinguished from the common use of the term in schools. Here we refer simply to how much initiative should rest with the child. Many well-meaning adults assume that they should provide maximum stimulation and given answers to all questions that arise. They take it for granted that, because they have given an answer, the child will learn it. Others claim that only what the individual discovers for himself is important to him. The teacher must often reach a balance between these positions.

Research in this field shows a reasonably high degree of agreement. From such studies we seem to find:

1. Either too little or too much guidance is ineffective. There is an intermediate point at which the optimal amount of guidance is reached. With progressively increasing amounts of guidance, learning becomes increasingly effective to a certain point, then decreases.

Help results in gain at first, then becomes detrimental if it is too long continued. Guidance at all points seems to affect speed more than it affects ultimate mastery.

The effect of too little guidance is that there is little growth or that the child becomes discouraged and moves away from the learning problem. The effect of too much guidance is even worse, especially when it is given late in the process of mastering a specific skill. Too much guidance results in increased variability, less effectiveness in learning, and less transfer. The learner seems to react as he does to dominance by developing active resistance to learning. The best learning occurs if guidance is given in small amounts, that is, if the learner discovers or seems to discover the answers for himself instead of having the right answers given to him.

2. The best timing for guidance is early in the development of a new skill. Relatively great amounts of initial guidance can be effective, as in demonstrating a new skill or tracing a new word for writing or formulating questions to be answered in a reading period. Some opportunity should be given at first to explore the material. Then the teacher may well suggest a short, concrete, easily remembered rule of action. It is important that the suggestion be made when the learner feels the need for help. Guidance may be detrimental when given at the wrong stage of action.

3. Guidance is most effectively given in symbolic form. Even when the teacher shows the child how to do something, the learner should remain the active agent in learning. If she tells him what to do, or uses verbal guidance, he must still translate the idea into action, and learn through the translation. If she demonstrates because words do not communicate effectively at his learning level, she should let him

make a maximum number of suggestions and give directions. She may ask him to describe the process as she does it, then let him tell her what to do, then do it himself.

If guidance must be manual, as in tracing, the learner moves his own hand as the teacher watches and tells him what to do. The teacher does not hold his hand and move it for him. Because it is so often passive, manual guidance is usually ineffective, sometimes even detrimental to learning, with human beings. Demonstration is usually superior to manual guidance for young children, and verbal guidance to demonstration for older and brighter students. The value in each case lies in the fact that guidance is symbolic and the learner retains the initiative in doing the act.

Guidance is best used to call attention to significant aspects of the problem and to suggest generalizations, followed by practice of the skill. With guidance used in this way, there is transfer because the same generalizations apply under other conditions, the child understands what they mean, and he has practice in applying them.

4. Guidance is best given in positive form. The studies of emphasis on right and wrong responses, referred to in the section of knowledge of results, also stressed this point. Stressing errors is superior to no guidance at all, so long as the learner retains the initiative, but correct guidance is better still. In teaching skills where there is only one correct response (as in spelling) it is important to avoid emphasizing errors, as we have already pointed out. But where there are several relatively good and relatively poor ways of reaching the same objective, as in science or social studies or procedures in handling materials, the learner should have freedom to try out his own methods of solution. The important thing is to let the student retain the initiative making suggestions at appropriate

points, and to let him follow through the procedures he wants to try even if they seem poor to us. Then, if he fails, the teacher can overlook his error and again make a positive suggestion.

III. PRINCIPLES RELATED TO INSTRUCTIONAL MEDIA, CONDITIONS AND MATERIALS

3.1 Modes of Instructional Presentation - The Use of Media

The primary modalities of the learner through which most learning occurs are the visual, auditory, and motor channels. It seems clear that no one sense modality alone is capable of ensuring thorough learning. The different modes of presentation tend to supplement and reinforce each other; several modes are often more effective than one. In a simple learning task such as spelling, best results may be expected when the child is asked to say and write the words he is spelling. The accuracy of his pronounciation would also contribute to his total spelling efficiency. Within limits, the greater variety of sensory avenues brought to bear on a subject or problem the more thorough will be the learning and the higher will be the retention. Numerous experimental studies designed to determine the effectiveness of the varied modes of presentation have been reported. Summaries of the results of this type of research are available, one being that by Allen*, who has generalized his findings as follows:

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*W. H. Allen, "Audio-Visual Communications" in Encyclopedia of Educational Research, 1960, Macmillan Company.

A. Motion Pictures

a. Knowledge of facts " ... films can teach factual information effectively over a wide range of subject matter content, ages, abilities, and conditions of use. This factual learning, however, tends to be rather specific to the information communicated by the film."

b. Perceptual-motor skills. "There is little doubt about the effectiveness of films in teaching perceptual motor skills."

c. Concepts. "Although a frequent criticism of instructional films is that learning from them is "passive" and interferes with thinking and the development of concepts and inferences, there is no experimental research to support this negative supposition. On the contrary, the evidence is on the side of the film in developing concepts."

d. Motivation, interests, attitudes, and opinions. "... films can modify motivations, interests, attitudes, and opinions if they are designed to stimulate or reinforce existing beliefs of the audience. There is, however, little evidence that films can make changes if they are contrary to the existing beliefs, personality structure, or social environment of the individual in the audience."

B. Television. "Teaching by television is effective at all levels of instruction from elementary school to military training. In very few cases has TV instruction been found to be inferior to conventional instruction, and in many cases TV was significantly more effective."

C. Radio and Recordings. ". . . relatively few basic studies have been made of the effectiveness of radio and recordings in teaching factual information and in changing attitudes and interests. In general, radio and recordings were found to be at least as effective as conventional teaching methods and to be liked by students."

D. Film Strips and Slides. ". . . the superiority of the motion picture probably resulted from the greater adaptability of movies for portraying interacting events, whereas the superiority of the filmstrip was probably due to the slower rate of development used in the actual presentation of the filmstrip to the audience."

Some implications for classroom practice:

1. Before deciding to use an instructional aid, a teacher should know its contents thoroughly. He should preview it to determine its possibilities for teaching a particular topic.
2. The learner should be prepared to watch for certain items in advance of their presentation and he should be held responsible for the information they provide. Such presentation may consist of giving some "hints" or pointers on significant materials to be observed. This preliminary preparation may also include reference to items not particularly relevant to the discussion at hand. If it is desired to measure the effect of

a particular aid, a pretest may be given. Such a test, when repeated after a showing, provides a basis for measuring the amount of learning that has occurred.

3. After seeing an aid, the group should have a discussion to develop the main points. This discussion should show the relationship the contents of the aid has to the topic under consideration and indicate any features that have been bearing on the effectiveness of the aid.

4. Instructional aids should receive consideration when tests are prepared to measure accomplishment. The effects of such aids may be measured immediately following their use, or they may be made a part of more comprehensive examinations to be given later. The point to be emphasized is that the learner should be held responsible for their content in the same manner that he is held responsible for any other material presented by textbook, teacher or collateral reading.

3.2 Conditions of Learning

A. Time Factors

1. The person who learns quickly also masters the learned material to a high degree and retains it over a long period of time. Speed and accuracy in learning are related. The child who knows his arithmetic processes best will finish the set of problems first. The concept of the slow learner as characteristically thorough is not borne out by experimental analysis.

2. The extent to which the more capable learner will be able to speed up is affected by how logical the material is, the intelligence of the learner, his purpose in learning, the difficulty of the material, the opportunities for using unlimited resources in learning, the continuity of the context, and the strength of the learner's motivation. In relatively routine and meaningless tasks there may be little relationship between speed and quality of learning.
3. Setting some time or work limit increases the intensity of work and hence the rate of learning. If time is introduced as a factor in planning the work of the day or even of the next fifteen minutes, work will be more effectively organized and will produce greater involvement on the part of the students.
4. Speed instruction should always include accuracy instruction, particularly in the early stages of learning. This approach suggests that accuracy is primary, and speed, in part, a result of accuracy. Even in later stages of learning, there should be a check on accuracy whenever work for speed is stressed.
5. Left to his own devices, the learner tends to adopt a consistent rate for problems of similar type. The rate is peculiar to the individual and relatively independent of intelligence. Urging a learner to modify his characteristic rate of work, except for brief intervals, will result in frustration for both teacher and pupil.

6. Changes in timing should be used in moderation. The effect of such changes as enforced rhythmic pattern, enforced delay at a critical point, or repeated change of speed show the same kind of effect as that discussed under degree of motivation. The initial adaptations, if they are easily within the ability range of the learner, result in somewhat greater tension and greater learning. If changes in time are often repeated or intensified, however, they disrupt learning.

B. Competition versus Cooperation

1. Competition increases the amount of work done, but quality remains the same or deteriorates. There is improvement with competition in simple mechanical tasks, but work on more difficult tasks is inhibited.
2. The more personal the competition, the greater its effect. Children prefer competition against their own records, and work under such conditions is as good as that done in competition against others. For older students, competition against another individual is superior to competition against a group.
3. For the learner to be motivated, he must think he has a good chance of success in competition. When he thinks he has no chance of winning, either because he has usually failed or because he knows his competitor is a champion, his attitude causes failure behavior. There is inhibition of overt response, lack of confidence, and physical tension growing out of the deflection of energy from thinking to feeling. Giving the learner a handicap

based on his previous record, however, permits him to feel that he might succeed, and increases the sureness of his learning and the energy he puts into the task.

4. Older students respond more to competition than do younger children. The reason is the decreasing social awareness that comes with age, combined with the home and school pressures that foster competitive attitudes. The critical period for the emergence of competition is from ages four to six. By the time the child enters the elementary school he is already responding to competitive stimuli, both these specifically imposed and those implicit in our culture.

5. Average or slow learners respond more favorably to competition than do rapid ones. Competition inhibits the performance of the rapid learner; he is more likely to have and respond to intrinsic or internalized standards where the average student develops internalized standards more slowly and hence, is more influenced by socially imposed demands. The rapid learner is more likely to think for himself and have highly individualized interests, goals, and conduct norms; the average student is more likely to be responsive primarily to social demands. The pressure of the culture is always toward conformity to the average in behavior. The less able learner has an upward pressure operating, one which raises his performance in relation to the social group; the more able learner feels a downward pressure from the same stimulation, a

pressure that scales his performance toward the average even though his own way of doing things may be better. The pressure of social forms of motivation is a leveling one, in which the more able learner gains less than the others. In addition, the bright student is more perceptive of the pressures in his environment, so that any pressure may easily become over-motivation for him. It is important to remember that the chief gain in competition lies in speed of performance, with no gain in quality of work. It is in quality of work that the rapid learner needs stimulation and then will respond favorably.

6. Cooperation may or may not be less effective than competition. Results are inconclusive, depending on the type of task or goal. The child is more highly motivated by work for self than he is by work for the group, although with experience in group work he comes to respond equally to the two forms of motivation. The balance that team rivalry provides between cooperation within the group and competition against another group combines the effectiveness of work for self with the social gains of work for the group.
7. The quality of interpersonal relations under cooperation is positive, that under competition is negative. Individual reward under competition is associated with increased variability of behavior, attacks on others, and increased speed of work without corresponding increase quality. Cooperation, on the other hand, leads to positive responses toward others, social freedom, group identification, greater interdependence of behavior, and in general more socialized

forms of behavior. Cooperation seems to have a more lasting effect than competition.

8. Groups that work best together are relatively small, homogeneous, self-chosen, and familiar. Those who have something in common can understand each other better, whether the common factor is an interest in building a store or the ability to read. Learners of the same sex work together better than those of opposite sex. Groups in which the individual chooses to work with certain others cooperate more easily than those which the teacher assigns, or even those in which the chairman chooses the participants. Groups of individuals who know and like each other accomplish more work than those that disregard such spontaneous choices.

9. Cooperation is a more advanced stage of social development than competition. It occurs more often among older students than among younger, though even animals cooperate. It occurs only as the result of training, however. It is particularly important for teachers to aid the development of cooperation.

C. Individual vs. Group Learning

1. Working in a group stimulates individual output. This stimulation occurs whether or not there is interaction between members of the group, though it is intensified with interaction. The learner shows greater speed, though the work tends to be of the same quality as that done alone. There is a heightened

activity level, and perhaps an unconscious competitive attitude. The increase is greater in routine tasks, though it is present to some extent in such activities as problem solving.

How well an individual performs in a group is related to his status, both actual and as he perceives it. If he is high in rank, or if his teacher makes him feel he has status, he will perform better. Social responses from teacher or classmates, even nodding the head or saying "Mmm" or listening attentively, can improve individual output, especially when the student has had little prior attention.

2. Attitudes toward work done under social stimulation are more favorable than attitudes toward work done alone. When a learner has worked with others on a task, he is more likely to continue to work on it when he is alone. When a classmate is introduced, the learner may be drawn back to a task of which he has tired.
3. Variability increases in the social situation. Social stimulation brings out the behaviors discussed previously as evidences of heightened motivation. Since social facilitation is mild, its effect is that of increasing the rate of activity.
4. Learners differ in the extent to which they are affected by social facilitation. Children under three are relatively unconscious of the presence of other children, hence show little social facilitation. Students of average mental ability show more social facilitation than very bright children; in fact, the bright child does his best work

alone, especially on relatively difficult tasks.

5. Group action affects the quality rather than the quantity of work done. Its effect is opposite to that of competition or an audience. Its benefits are greatest in solving difficult problems requiring insight and originality, not in routine tasks. For example, a group will be better able than an individual to handle a problem of behavior or a controversial issue; but group work will have little advantage in arithmetic drill or simple construction. The group takes longer to reach a decision and longer to recall and use experience, but given plenty of time it makes more effective decisions than the individual. It also recalls and uses material more completely.

6. The superiority of group work increases with each increase in the size of the group, though at a decelerating rate. A large group turns out better work than a small one, but adding another person to a group of three makes more difference than adding another person to a group of ten. There is often increasing stratification in groups of more than five; students are less able to handle the complex interaction in a large group and prefer small groups. Though large groups get somewhat better work done, the gain is often offset by the problems generated.

7. The group is influenced more by the better-informed members than by those who are poorly informed. This observation holds no matter how enthusiastic or dominant the poorly informed may be, provided the task is clearly structured and within the comprehension of the membership. Only if the task is ambiguous or too difficult for the group will the members

turn to those whose enthusiasm makes them seem to be informed. Older children influence a group more, and younger children are more subject to group pressures, a relationship which is a product of mental development and social experience. It is doubtful whether children are ready for much team work before the age of nine or ten. Relatively bright individuals influence the group more than the less bright, because they have more information available and are able to use it more flexibly. The teacher influences a group as one individual only; she does not dominate. By definition, those who influence most are least influenced by the group.

8. Individual participants in group work learn more than individuals of equal ability working alone. This difference is in part due to social facilitation and in part to the increased flow of ideas. The gain carries over to individual work done following group work. Once a group judgment is made, it tends to be fixed and to affect later individual behavior. The chief exception is that the most able students have a chance to work with other able students in order to experience the stimulating effect of group work. If they are always the most able, they develop an aversion to group work.

9. Work done by a group is distinctly superior to that done by the average member of the group, and equal to that of the best member. The effect of group work is not an averaging but an additive one so far as the job done is concerned. There is a gain with the addition of each member. The degree to

which work will be better than that of the same individuals working alone depends on how much more able the best members are than the average of the group. For example, a decision on a rating worked out in conference is more accurate than that made by the same persons working individually and averaging their independent ratings. The gain may be due to the increased range of information present in a group, the varied interpretations of facts, the scattering of errors, the testing of ideas by others, the more critical attitude with which the individual approaches group work, and the fact that the group frees the individual from personal threat and makes him more willing to try new ideas.

10. Only in an interacting group are the benefits of group work felt. For group work to be effective, each individual must be aware of the underlying motivations of the others, and want others to reach their goals as well. The group must work together toward mutually defined solutions. If the group is simply an aggregate of individuals without interaction, there will be little gain.

4. A Summary of Skill Learning in Vocational Education

Assuming expertise, the usual procedure in beginning skill instruction is to explain the essence and purpose of the task. Verbal instruction is an essential part of skill learning, and, as such, it should achieve a definite purpose. The goal of verbal instruction is understanding so that, primarily, learners may comprehend why they are learning a particular task, and secondarily, they may apprehend the parts and their relation to the whole.

Such verbal instruction will help to stimulate motivation because through verbal instruction the instructor enables the students to realize the value of the task. Motivation is usually not a problem in motor learning because knowledge of results is instantly obtained. The chief danger in the use of verbal instruction during the introduction of a motor skill is that the teacher may include excessive facts and thus confuse students.

When the instructor thinks that the learner understands the vital relationships of the task, he may show how it is to be done. Pictures, diagrams, movies, models, or whatever is deemed effective should be used. These tools should emphasize the form of the skill and should be presented with continued verbal instruction to enforce understanding. Here, the learner actually sees what the correct form is, that is, how the expert performs his task. But demonstration can only be used to increase comprehension, to grasp the total act, or to enhance the learner's perception of the part-whole relationship.

Finally, the instructor must launch the beginner on his own way, and it is here that superfluous instruction may create a feeling of dependency. Frequently, instructors aid the student too quickly. Instructors should allow the learner to make mistakes, this is part of the learning process. But, he should be there to discourage frustration or permanent error.

How can this best be accomplished? Not by physically manipulating the learner through the act! The golf instructor who moves the beginner's arms through the swing or the teacher who guides the pupil's hand during penmanship class are not teaching properly because this kind of instruction creates an entirely different task. Perhaps the only time when such instruction is warranted is if the pupil has a physical handicap and needs aid in

sensory adaptation.

After beginners initiate the task themselves, the best method of instruction is verbal together with the actual movements the learner is discharging.

The student cannot be a spectator: he must participate. He must engage in purposeful activity because it is precisely here that he is applying the parts and the whole to the attainment of the goal. He understands the relations of the task to the goal, and, unless he has the opportunity to utilize his skill, there will be a loss of motivation and a corresponding disintegration of expertise.

The conditions of practice, although as real and meaningful as possible, must also encourage and not discourage. Fatigue and dismay at early errors must be avoided by brief, carefully spaced practice periods. As skill increases, the periods of practice may be longer and more frequent until the point where additional overlearning might lead to boredom and carelessness. Then, widely spaced practice periods to insure retention of a high degree of skill are all that will be needed.

CONCLUSION.

Psychomotor skills are the foundation of much of man's behavior, both physical and verbal. Any difficulty with motor learning, either because of physical handicap or faculty learning will greatly hinder man's adjustment to his environment. The motor skills are learned in the identical way as other kinds of learning, but, because of the more obvious physical characteristics of skill acquisition, the notion of understanding is often omitted. Yet true motor learning occurs only when there is perception of the task and the purpose for which the skill is to be used. Finally, to a certain extent, all teachers are teachers of motor skills.

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